

Haze Blocks the Windows to the Soul: The Role of Anonymity in the Unethical Effects of Air Pollution

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Abstract

Objective: Air pollution is a global concern with both health and psychological costs. Drawing upon the unethical impacts of air pollution, this paper proposes that haze could give rise to immoral tendencies through enhanced anonymity.

Methods & Results: Big data analysis of daily web searches across a period of three years revealed that an increase in web searches for immoral words was associated with hazy days. Three subsequent experiments established the causal effects of psychologically experiencing haze or personally experiencing hazy days on immoral intentions and cheating behaviors. Moreover, these effects were mediated by perceived anonymity, intensified by the low visibility in haze. In support of deindividuation, masking, which could boost perceived anonymity, amplified the unethical effects of air pollution.

Conclusions: Taken together, these findings suggest that perceived anonymity was a key psychological process underlying the unethical effects of haze. The findings of the study provide insights for researchers and policy makers to tackle the adverse effects of anonymity, especially on polluted days.

Keywords: Haze; Anonymity; Unethical behavior

1. Introduction

Air pollution has become a global environmental issue over the past hundred years, and the relationship between air pollution and behavior has received considerable attention with respect to its psychological impacts (Rotton et al., 1978; Szyszkowicz, Willey, Grafstein, Rowe, & Colman, 2010). Alongside the social effects of air pollution (Gong, et al., 2020), haze is not only highly polluting and harmful to physical health, but also gives rise to immoral social behaviors (Kim et al., 2012; Li & Peng, 2016). However, there remains a paucity of evidence on how air pollution contributes to unethical behavior.

The perceived anonymity provided by haze may address the link between unethical behavior and air pollution. First, anonymity could be generated from low visibility during haze (Rajper, Ullah, & Li, 2018), which further adversely affects morality. A dark-room effect showed that people in dimly lit environments were more prone to antisocial behavior, and dark rooms were more likely to cause aggressive behavior and crimes (Karnes, 1960; Hartley, 1974; Hegarty & Sims, 1978; Page & Moss, 1976). Secondly, the level of anonymity is enhanced when people often wear a mask to prevent breathing in air pollutants on hazy days; unethical acts have been proven to be more frequent when individuals are masked or disguised (Mathes & Guest, 1976; Kerr, 1999; Sassenberg & Postmes, 2002). Moreover, people wearing sunglasses may become more selfish (Zhong, Bohns, & Gino, 2010). Also, participants shocked more when being made anonymous by masks and overalls reminiscent of the Ku Klux Klan (Zimbardo, 1969; Johnson & Downing, 1979). This suggests that during the outbreak of several riots over recent years, it may be the anonymity that had an overall effect on the aggressive tendency which produced antinormative behaviors.

The purpose of the present study was to investigate the impact of air pollution on morality and elucidate the possible underlying role of anonymity. Specifically, we suggest that under haze, when individuals perceive themselves to be more anonymous, produced by lowered visibility or masking, unethical behaviors may be produced.

2. Literature review

2.1 Air pollution predicts unethical behavior

Unethical behavior is morally unacceptable and strongly prohibited by law or societal expectations (Kaptein, 2008). Studies have suggested a positive correlation between air pollution and unethical behaviors (Lu, 2019). For example, a positive correlation was found between increased criminality (aggressive and violent behaviors) and air pollution (Anderson, 2001; Cohn & Rotton, 2005). Moreover, participants who felt “physically clean” (as opposed to those who were led to feel “physically dirty”) tended to make more severe moral judgments on various social issues (Zhong, Strejcek, & Sivanathan, 2010). More importantly, a recent study proposing the “clear sky” effect

provided further information on the ethical costs of air pollution, in which participants reported higher levels of perceived corruption subsequent to recalling feelings concerning haze or experiencing hazy days (Huang, Zheng, Tan, Zhang, & Liu, 2016). Supporting this line of reasoning, air pollution (and haze in particular) could wreak havoc on morality (Hypothesis 1).

2.2 Air pollution, anonymity and unethical behavior

Anonymity is defined as “non-identifiability,” and it raises the issue of accountability (Wallace, 1999). There are several approaches to studying increasing anonymity, such as disguising participants’ physical appearance (Miller & Rowold, 1979), preventing participants from chatting to each other (Propst, 2010), or seating participants in a dimly lit room (Spivey & Prentice-Dunn, 1990). Anonymity on hazy days could be at a high level, which could be associated with certain psychological impacts.

On the one hand, air pollution and haze can induce dark smog, which decreases visibility and promotes anonymity. The main pollutants causing haze are the primary factors leading to a decline in visibility (Rajper, Ullah, & Li, 2018). Anonymity initiated by darkness and invisibility as a result of air pollution conceals people’s identity and decreases their inhibitions, after which unethical behaviors are more likely to occur. In fact, criminality is most likely to occur during darkness (Hegarty & Sims, 1978), and dark rooms have been found to promote aggressive behavior (Page & Moss, 1976). Studies have also shown that participants in a room with slightly dimmed lighting earned more undeserved money than those in a well-lit room, and participants wearing sunglasses acted more selfishly than those wearing spectacles with clear lenses (Zhong, Bohns, & Gino, 2010). Therefore, anonymity generated from the dark smog would play a mediating role between air pollution and antisocial behavior (Hypothesis 2).

On the other hand, the ethical effects of haze are expected to be most pronounced if individuals are wearing a mask, which provides a greater sense of anonymity. Owing to severe air pollution, there is an increasing tendency for people to wear face masks on polluted days to ward off the effects of heavy haze. For instance, the haze crisis in 2013 in South Asia led to massive demand to stock-up on N-95 masks (Ho et al., 2014). However, masking contributes to deindividuation, meaning that people become more likely to engage in disinhibited behavior that violates social norms (Zimbardo, 1969). Anonymity has been examined in connection with behavior that is self-interested (Kerr, 1999), antisocial (Silke, 2003), and unethical (White, 1977). Thus, we hypothesized that people wearing a face mask would be more likely to behave unethically under pollution (Hypothesis 3).

Interestingly, some researchers have proposed that polluted air influences morality due to its influence on negative emotions (e.g., anxiety) (Lu, Lee, Gino, & Galinsky, 2018; Xiang, Geng, Zhou, & Cheng, 2017). For example, Lu et al. (2018) found that air pollution heightened anxiety, which, in turn, increased unethical behavior. However, the mediating role of negative affect is not consistent across

studies (Huang et al., 2016). Whether negative affect could explain the link between air pollution and morality requires further investigation.

2.3 Overview of our studies

The purpose of this study was to investigate the relationship between haze and immorality. More importantly, this study aimed to unravel the role of anonymity in the unethical effects of air pollution, and to ascertain the mediating role of negative affect. Hypotheses were tested in four studies conducted using big data, field observation and experimental design. In Study 1, air pollution and unethical behavior were examined with a focus on the Baidu Index™ as a form of big data to explore the causal relationship between air quality and immoral tendency. To explore if anonymity might be one of the underlying mechanisms of the ethical costs of haze, Study 2 manipulated perceived air pollution with priming to examine whether psychologically experiencing haze and fog led to a higher quantity of immoral behaviors. Study 3 then examined directly whether the unethical effect of haze was mediated by the perceived anonymity produced by the low visibility of polluted days in real-life situations. Finally, Study 4 ascertained whether wearing a face mask, which intensified perceived anonymity, would boost the ethical effects of haze. Therefore, the study set out to provide a more in-depth understanding of perceived anonymity as a key psychological process underlying the unethical effects of haze.

3. Methodology (Design/Approach)

3.1 Study 1: Analyses of big data

Study 1 explored the association between air pollution and unethical behavior by using big data, in the form of Internet searches. In general, Internet searches should be a suitable tool to gain access to conscious cognitive awareness and behavioral tendencies (Broder, 2002). Research studies have used Google Trends™ to predict a range of outcomes: economic prospects, disease outbreaks, and political movements (e.g., Carneiro & Mylonakis, 2009). In China, instead of Google, the most frequently used search engine is Baidu. The Baidu Index offers the same function as Google Trends, stating when search terms were inputted. Hence, we focused on the Baidu Index as a form of big data to investigate different ethical tendencies under conditions of different air quality. We expected that on hazy days, the search volume for immoral words would be larger than that on clear days, while there would be little difference for moral words.

3.1.1 Data collection

Air quality. We sourced the daily data on Beijing air pollution between 2017 and 2019 from National Air Quality Monitor Net (www.cnpm25.cn/city/beijing.html). The Air Quality Index (AQI) is based on the level of six atmospheric pollutants and is responsible for measuring the level of air

pollution in China (Ministry of Environmental Protection of the People's Republic of China, 2018). According to the pollution standards, when the AQI is < 50 the weather is classified as “clear”; when AQI is > 100 , the weather is classified as “hazy.” Between 2017 and 2019 in Beijing, there were 247 clear days and 316 hazy days in total.

Moral tendency. Ten words were adapted from the Moral Awareness word list (Barnes, Gunia, & Wagner, 2015), which was generated according to contents and word frequency. Five words served as representing the content of web searches with an immoral tendency (“Corrupt,” “Fraud,” “Sin,” “Steal,” “Cheat”) and five to represent those with a moral tendency (“Ethics,” “Fair,” “Honest,” “Truth,” “Principle”). To validate that the terms classified as Moral Words were higher in moral content than those classified as Immoral Words, a pilot study with 30 participants was conducted. Participants rated the degree that each word related to immorality on a seven-point scale. The daily search volume in the Baidu Index for each of the terms from 2017 to 2019 in Beijing was web scraped by codes written in Python 3.5 code (detailed codes are shown in the Appendix). The Baidu Index made available for the normalization against the search volume for regions and dates specified in search queries.

3.1.2 Results

Validation of the terms classified as Moral Words and Immoral Words showed that the ratings of the immorality of terms classified as Immoral Words ($M = 6.13$, $SD = 0.51$) were significantly higher than those of terms classified as Moral Words ($M = 2.01$, $SD = 0.35$), $t(29) = 34.74$, $p < .001$, Cohen's $d = 9.42$. Thus, it was appropriate to contrast the web search activity for terms classified as Moral Words and Immoral Words.

A two-way repeated ANOVA examined the differences in the Baidu Index for different search categories and air quality. A significant main effect of word category was found ($F(1, 561) = 4049.74$, $p < .001$, $\eta^2 = 0.88$), indicating a higher volume of web searches for Moral Words ($M = 154.56$, $SD = 23.17$) compared with those for Immoral Words ($M = 100.36$, $SD = 25.36$). There was no main effect of air quality ($F(1, 561) = 1.35$, $p = .246$, $\eta^2 = 0.002$). However, more strikingly, an interaction effect of word category and daily air quality was revealed ($F(1, 561) = 18.05$, $p < .001$, $\eta^2 = 0.03$). Further tests revealed that for Moral Words, no significant differences were found between web searches on clear days ($M = 155.39$, $SD = 25.49$) and hazy days ($M = 153.91$, $SD = 21.18$), $F(1, 561) = 0.56$, $p = .453$; however, for Immoral Words, an increase in web searches was associated with hazy days ($M = 102.91$, $SD = 25.09$) compared to clear days ($M = 97.09$, $SD = 25.39$), $F(1, 561) = 7.38$, $p = .007$, $\eta^2 = 0.13$. This indicated that low air quality was related to a higher volume of web searches for immoral words (Figure 1).

Insert Figure 1 here.

3.1.3 Discussion

By analyzing big data from the Baidu Index, Study 1 provided evidence that on hazy days, people tended to search more for immoral words, indicating a higher tendency for unethical behaviors. However, air quality was not correlated with a difference in web searches for moral words, indicating that the increase in immoral tendency on hazy days was not caused by a general increase in moral awareness. The results supported the view that air pollution could increase an unethical tendency.

Although the findings from Study 1 provided some hints on the ethical effects of air pollution, it lacked evidence indicating that anonymity played an important role in the unethical costs of haze. Therefore, Study 2 aimed to ascertain if the anonymity provided by the invisibility of hazy days could explain the link.

3.2 Study 2: Effect of air pollution on morality

Study 2 first examined whether psychologically experiencing haze would result in some unethical consequences. Secondly, to examine whether anonymity plays an important role in the ethical effects of haze, hazy days were distinguished from foggy days. During foggy days, although the air is not polluted, it leads to poor visibility and perceived brightness, just as on hazy days. Therefore, hazy days and foggy days bring about a higher level of anonymity than on clear days. If anonymity is one of the underlying mechanisms of the ethical costs of haze, then unethical behaviors would be as likely to appear on hazy days as on foggy days. Moreover, the role of negative affect on the unethical effects of pollution was examined to test whether anxiety is a mediating mechanism in reduced morality.

3.2.1 Methods

Participants

G*Power was used to determine the sample size in order to achieve a medium-to-large-sized effect and a power of 85%. A total of 126 undergraduate and graduate students (42 males, $M_{\text{age}} = 19.96$, $SD_{\text{age}} = 1.61$) were recruited in this experiment and received either course credits or monetary rewards for their participation. The experiment was ethically approved by the Institutional Review Board for Human Participants.

Design

A between-participant design was used, with participants randomly assigned to three conditions: polluted, clear and foggy.

Materials

Experimental manipulation. A series of photographs of contemporary cities displayed on a computer monitor were shown to participants. There were 20 photographs in each group, featuring a polluted version, a clear version, and a foggy version of the same geographical location. One

photograph was taken on a polluted day (i.e., smoggy sky, low visibility), one was taken on a clear day (i.e., clean sky, high visibility), whereas another was taken on a foggy day (i.e., clean sky, low visibility) (Figure 2). While viewing the photographs, individuals were required to imagine that they were living in that city. Then, participants were asked to complete a detailed diary in 3–5 min about living in the city, and were given the following instruction: “Go through the city on a day like this as if you were there as a local, looking around, taking a bus, exploring the city, going to classes, riding a bike, breathing the air, talking with your friends” (Lu, et al., 2018, pp. 350).

Insert Figure 2 here.

Manipulation check. Participants were asked to assess the perceived air quality and visibility on a seven-point Likert scale (1: “extremely bad,” 7: “extremely good”). The perceived light quality was rated as “drab–clear,” “subdued–brilliant,” “dark–light,” “shaded–glaring,” “mild–sharp,” and “unfocused–focused,” from 1 to 7 (Johansson, Pedersen, Maleetipwan-Mattsson, Kuhn, & Laike, 2014). The Cronbach’s α score was 0.98.

Emotions. Emotions were measured by the Positive and Negative Affect Schedule, Chinese version (PANAS–X: Watson, Clark, & Tellegen, 1988; PANAS–X–Chinese version: Guo & Gan, 2010). It consisted of 18 words and phrases that describe positive and negative feelings. Individuals rated each word or phrase on a five-point Likert scale (1: “very slightly or not at all” and 5: “extremely”) according to their feelings at that time. The Cronbach’s α scores of positive and negative affect were 0.97 and 0.95, respectively.

Unethical decision-making. A scenario-based measure of unethical decision-making was used to assess participants’ moral judgments (Detert, Treviño, & Sweitzer, 2008). Eight “ethically charged” scenarios were introduced and participants were instructed to imagine themselves as the target person in each ethical situation. A sample scenario was “You work in a fast-food restaurant in downtown [City X]. It’s against policy to eat food without paying for it. You came straight from classes and are therefore hungry. Your supervisor isn’t around, so you make something for yourself and eat it without paying.” Participants were asked to evaluate three questions concerning likelihood judgment, acceptability and moral attitude on a seven-point Likert scale. The Cronbach’s α scores for the scales were 0.69, 0.73 and 0.72, respectively.

Cheating behavior. A problem-solving matrix task was also used to measure unethical behavior (adapted from Kouchaki & Wareham, 2015). Participants were instructed that they would earn an additional 0.5 yuan for each correctly solved matrix (i.e., “Find the two numbers in the matrix that add up to 10”) and were presented with 20 matrices of 12 three-digit numbers (e.g., 3.86) appearing on the screen for 15s each (Figure 3). Participants were asked to only point out whether or not they found the matching pair for each matrix. Half of the matrices ($n = 10$) were solvable (i.e., containing two numbers adding up to 10), whereas the other half were unsolvable (i.e., not containing two numbers adding up to 10). Thus, if a participant reported having solved a pair in a matrix that could not be

resolved, it indicated clearly that he/she was cheating with regard to the matrix. This task made allowance for measuring cheating behavior, as represented by the number of reported resolution matrices that were unsolvable.

Insert Figure 3 here.

3.2.2 Results

As expected, participants' assessments of air quality varied by condition ($F(2, 123) = 216.18, p < .001, \eta^2 = 0.78$). In particular, participants rated significantly lower levels of air quality in the haze condition ($M = 1.45, SD = 0.89$) compared with the fog condition ($M = 2.02, SD = 0.84, t(82) = 3.03, p = .003$, Cohen's $d = 0.66$), and clear condition ($M = 5.79, SD = 1.32, t(82) = 17.68, p = .039$, Cohen's $d = 3.86$), respectively. Also, foggy days were evaluated as having worse air quality than clear days ($t(82) = 15.61, p < .001$, Cohen's $d = 3.41$). With regard to visibility, participants primed with haze ($M = 1.90, SD = 1.03, t(82) = 16.18, p < .001$, Cohen's $d = 3.54$) and fog ($M = 2.31, SD = 0.72, t(82) = 16.43, p < .001$, Cohen's $d = 3.5$) photographs reported lower levels of visibility than for the clear condition ($M = 5.88, SD = 1.21, F(2, 123) = 197.89, p < .001, \eta^2 = 0.76$); but no significant differences were found between haze and fog conditions ($t(82) = 2.09, p = .205$). The same pattern of results appeared for light quality. These data suggested that the priming pictures were successful in guiding participants to experience three types of weather. Specifically, although foggy days and hazy days were rated as having low visibility and light quality, the haze condition was considered more polluted than the fog condition.

Examination of the emotional effects of different conditions revealed significant between-participant results for positive affect ($F(2, 123) = 127.57, p < .001, \eta^2 = 0.68$) and negative affect ($F(2, 123) = 70.58, p < .001, \eta^2 = 0.53$). Participants primed with haze experienced higher levels of negative emotions ($M = 2.98, SD = 0.92$) and lower levels of positive emotions ($M = 1.42, SD = 0.50$) than participants in foggy conditions (respectively, $M = 2.46, SD = 0.82, t(82) = 2.74, p = 0.023$, Cohen's $d = 0.60$; $M = 1.86, SD = 0.62, t(82) = 3.65, p = .001$, Cohen's $d = 0.78$) and clear conditions (respectively, $M = 1.16, SD = 0.26, t(82) = 12.39, p < .001$, Cohen's $d = 2.69$; $M = 3.57, SD = 0.80, t(82) = 14.74, p < .001$, Cohen's $d = 3.22$). Moreover, fog priming elicited greater negative affect and lower positive affect than clear priming (respectively, $t(82) = 9.89, p < .001$, Cohen's $d = 2.13$; $t(82) = 10.92, p < .001$, Cohen's $d = 2.39$).

As predicted, the acceptance of immoral behaviors in scenario tests differed across conditions ($F(2, 123) = 6.74, p = .002, \eta^2 = 0.10$). Participants in haze ($M = 3.60, SD = 0.97$) and fog ($M = 3.84, SD = 0.95$) conditions, compared with the clear condition ($M = 3.11, SD = 0.83$), had greater acceptance of immoral behaviors (respectively, $t(82) = 2.46, p = .016$, Cohen's $d = 0.54$; $t(82) = 3.71, p < .001$, Cohen's $d = 0.81$). Also, participants primed with a clear sky had higher levels of moral regulation, F

(2, 123) = 5.21, $p = .007$, $\eta^2 = 0.08$. Individuals in the clear condition ($M = 2.43$, $SD = 0.80$) had lower scores on the should/should not subscale than those in fog ($M = 2.93$, $SD = 0.71$, $t(82) = 3.03$, $p = .033$, Cohen's $d = 0.66$) and haze conditions ($M = 2.93$, $SD = 0.93$, $t(82) = 2.63$, $p = .010$, Cohen's $d = 0.58$). Moreover, there were no significant differences between the haze condition and fog condition for moral acceptance or moral attitude (respectively, $t(82) = 1.13$, $p = .889$; $t(82) < 0.001$, $p > 0.05$). Interestingly, differences were not found on the likelihood subscale. This might have been due to the “social desirability” of this measure, which contributed to recognition of other factors that led to these decisions. Thus, the likelihood scale may be a less direct measure of moral judgments.

Regarding the problem-solving matrix task, priming conditions had a significant effect on the number of cheating episodes ($F(2, 123) = 5.47$, $p = .005$, $\eta^2 = 0.08$). Participants in the haze ($M = 3.50$, $SD = 3.34$, $t(82) = 3.49$, $p = .001$, Cohen's $d = 0.76$) and fog conditions ($M = 3.12$, $SD = 3.49$, $t(82) = 2.73$, $p = .008$, Cohen's $d = 0.59$) reported solving more unsolvable matrices than those in the clear condition ($M = 1.50$, $SD = 1.63$). Haze priming and fog priming did not lead to differences in cheating ($t(82) = 0.51$, $p = .940$). This indicated that participants in all conditions cheated to some extent, but haze priming and fog priming gave rise to more cheating.

However, neither priming conditions (clear = 0, foggy = 1, hazy = 2) ($b = 0.54$, $SE = 0.45$, $p = .236$) nor negative affect ($b = 0.50$, $SE = 0.35$, $p = .157$) were correlated significantly with occurrences of cheating in the multivariate model. As a result, negative emotions were not a significant mediator between weather and cheating (95% CI $[-0.30, 1.19]$).

3.2.3 Discussion

Study 2 used experiments to establish the causal relationship between hazy weather and unethical behaviors, revealing that on hazy days people were more likely to be involved in cheating. The findings also indicated that experiencing haze discouraged moral acceptability and attitudes with greater acceptance of immoral behaviors and lower levels of moral regulation. These data are in accordance with Hypothesis 1.

More importantly, haze and fog led people to behave unethically to the same level. Although foggy days have low visibility, they have better air quality than hazy days. Thus, it might not be the pollution itself on hazy days that led to more cheating, but the anonymity provided by low visibility on hazy days. This preliminary result refuted the notion that air pollutants license more unethical behaviors. Instead, the dim and vague sky during hazy days might be the cause.

In addition, although negative emotions were increased by air pollution, results showed that the unethical effects of haze were not mediated by negative emotion. This is not consistent with previous studies. Lu et al. (2018) compared the anxiety level of participants primed by hazy days and clear days, and found that air pollution heightened anxiety, which in turn increased unethical behavior. This might be due to different measurements of negative emotions. In our study, the mediation effect of

negative emotions tested with PANAS scales was found to be insignificant (Huang et al, 2016), while with the anxiety scale Lu et al. (2018) found polluted morality to be mediated by anxiety.

3.3 Study 3: Mediating role of anonymity

Although Study 2 suggested that air pollution could license unethical behavior, there was a lack of direct evidence showing that anonymity is an important mediator in the ethical costs of haze. In addition, laboratory experimental designs lack the external validity to verify if an ethical effect also occurs in real-life situations. Hence, Study 3 sought to ascertain if the moral costs of air pollution through anonymity could be applied to real life.

3.3.1 Methods

Participants

G*Power was used to determine the sample size in order to achieve a medium-to-large-sized effect and a power of 85%; 38 participants were needed in each condition (hazy and clear days). Four extra participants each condition were recruited, resulting in 84 individuals (21 males, $M_{age} = 21.49$, $SD_{age} = 2.41$) in total. Participants were recruited via face-to-face encounters outside a student shop of a university in Beijing. The Institutional Review Board for Human Participants approved the execution of the research.

Design

A between-participant design was used. Participants were reached either on hazy days or clear days; all participants were selected randomly.

Materials

Air pollution. The study was conducted across four days in April 2019. We categorized the weather as “hazy” (AQI > 100) or “clear” (AQI < 50) according to data published on National Air Quality Monitor Net (Table 1). Also, participants were asked to rate the perceived air quality and perceived visibility for a manipulation check.

Insert Table 1 here.

Anonymity. The five-item anonymity measure (Zhong, Bohns, & Gino, 2010) was adapted to assess the extent to which individuals perceived themselves to be anonymous under the weather condition that day (e.g., “With the weather conditions today, I am likely to be watched”). Participants indicated their agreement with a seven-point Likert scale (1 = “strongly disagree,” 7 = “strongly agree”). The Cronbach’s α score of the scale was 0.52.¹

¹ Previous studies have revealed that Cronbach’s α could be accepted at around 0.6 when conducting psychological researches (Devellis, 1991), thus it is still reasonable to use the scale.

Cheating behavior. The problem-solving matrix task used in Study 1b was conducted to measure unethical behavior (adapted from Kouchaki & Wareham, 2015). The 20 matrices were the same as those in Study 1b, except that the matrices were printed on hard copy for participants to carry out the task on the questionnaire. Cheating behavior was represented by the number of ticked resolution matrices that were unsolvable.

Results

Descriptive statistics and correlations are shown in Table 2. As a manipulation check, participants reported significantly lower air quality on hazy days relative to those reported on clear days ($t(82) = 6.35, p < .001$, Cohen's $d = 1.39$). Participants' ratings of visibility of the day were significantly lower when it was hazy than when it was clear ($t(82) = 4.17, p < .001$, Cohen's $d = 0.91$). Thus, the participants' responses corresponded with actual haze data.

As expected, participants experiencing hazy weather reported a significantly higher level of perceived anonymity compared with those who experienced clear weather ($t(82) = 2.64, p = .010$, Cohen's $d = 0.58$). More importantly, participants on hazy days reported solving a higher number of unsolvable matrices than those on clear days ($t(82) = 2.52, p = .014$, Cohen's $d = 0.55$). These results showed that participants who did the task on hazy days cheated more.

Mediation analysis indicated that haze had a significant effect on perceived anonymity ($b = 0.45, SE = 0.17, p = .010$), which in turn affected the reported number of unsolvable matrices significantly ($b = 1.08, SE = 0.38, p = .006$). The effect of haze was reduced (from $b = 1.55, SE = 0.61, p = .014$ to $b = 1.06, SE = 0.61, p = .088$) when perceived anonymity was included in the equation. This indicated that perceived anonymity mediated the effect of air pollution on cheating behavior, 95% CI = [0.073, 1.039] (Figure 4).

Insert Table 2 here.

Insert Figure 4 here.

3.3.2 Discussion

Study 3 replicated the findings of Study 2 in real-life situations when individuals experienced haze physically. The results provided support for the mediating role of anonymity provided by low visibility as predicted by Hypothesis 2. On hazy days, people perceive themselves to be more anonymous which, in turn, increases their tendency to behave unethically.

3.4 Study 4: Perceived anonymity of masking

In hazy weather, people's perceived anonymity is increased not only because of the low visibility of the day, but also due to masking, which derives from the intention of preventing themselves being exposed to air pollutants. In Study 4 we examined, preliminarily, whether wearing a mask would

result in more unethical behaviors. Moreover, we examined the role of anxiety again to verify the previous finding of whether negative emotions, especially anxiety, might play a mediating role in the relation between air pollution and immorality.

3.4.1 Methods

Participants

G*Power was used to determine the sample size in order to achieve a medium-to-large-sized effect and a power of 88%, leaving 30 participants for each condition. Therefore, a total of 120 undergraduate and graduate students (25 males, $M_{\text{age}} = 21.07$, $SD_{\text{age}} = 2.30$) were recruited in this experiment. They received course credits and money rewards for their participation. The research was carried out under the approval of the Institutional Review Board for Human Participants.

Design

We used a 2 (air priming: fog, haze) \times 2 (masking: yes, no) between-participants design. Participants were assigned randomly to one of the four conditions.

Materials

Anonymity manipulation. In the masked condition, participants were asked to wear a gauze mask before entering the laboratory (Figure 5). Participants in the control condition took part in the study without a mask.

Insert Figure 5 here.

Haze priming. Participants were exposed to the polluted version or foggy version of the photographs (the same procedure as in Study 1b). The Cronbach's α score of the light-quality scale was 0.83.

Manipulation check. The anonymity of masking was confirmed with a five-item measure of perceived anonymity (e.g., "My choice went unnoticed during the study.") (Zhong, Bohns, & Gino, 2010). Participants indicated their agreement with a seven-point Likert scale (1 = "strongly disagree," 7 = "strongly agree"). The Cronbach's α score was 0.74.

Anxiety. Six items ("anxious," "calm," "neutral," "relaxed," "tense," and "upset") adapted from the short Spielberger State-Trait Anxiety Inventory (Marteau & Bekker, 1992) were used to measure the extent to which participants felt during that time (1 = "not at all," 4 = "very much"). The Cronbach's α score was 0.69.

Unethical behavior. Participants undertook a dot estimation task (Figure 6) to ostensibly assess their memory ability but in reality this measured cheating (Lambirth, Gibb, & Alcorn, 1986). Participants were presented with a series of pictures with a white background and 80 blue dots. The task instructed them to judge whether the left or right side had more dots: pressing "A" for left and "L" for right. In fact, the dots were scattered randomly, with the same number on the left and right sides. After 50 ms of fixation, the picture lasted for only 100 ms, which made them hard to detect.

After each trial, participants received feedback by judging their estimation as “right” or “wrong.” The more “right” trials, the more monetary rewards they would receive. However, participants were told that a bug in the program had still not been fixed and would not have any log records about the bug. If they pressed the key “H,” then they would be judged to have made a correct estimation, and receive the feedback of “right.” Thus, the experimenter asked them not to press “H.” There were 40 trials in total, and the number of trials in which participants cheated by pressing “H” was actually recorded.

Insert Figure 6 here.

Procedure

Before entering the room, participants assigned to the masking condition were asked to wear a gauze mask throughout the study. Participants in the masked group were told that this was an experiment to examine the functions of a new brand of mask, which functioned as a cover story to disguise the purpose of the study. Participants were asked first to complete the priming task and complete a 5-min diary about how they would feel living in the city. Then, they were asked to evaluate the light quality and complete the anxiety measurement. Next, they were presented with the dot estimation task to test their cheating behavior, followed by a manipulation check of anonymity. Finally, demographic information was collected and participants in the masking group were asked to answer two questions about the comfort and protection of the mask. None of the participants in the masked or unmasked group figured out the actual purpose of the study.

3.4.2 Results

As expected, participants’ assessments concerning the air varied according to the condition. When examining perceived air quality, a significant main effect of priming condition was found ($F(1, 116) = 9.53, p = .003, \eta^2 = 0.08$). Participants primed by haze photographs rated significantly lower levels of air quality in the haze condition ($M = 1.38, SD = 0.59$) compared with those in the fog condition ($M = 1.80, SD = 0.86$). No main effect of masking ($F(1, 116) = 0.75, p = .39, \eta^2 = 0.01$) or interaction effect ($F(1, 116) = 0.02, p = .90, \eta^2 = 0.00$) was found. Also, no significant effects or interactions were found on the ratings of visibility ($p_s > .05$) or light quality ($p_s > .05$). These data suggested that the priming pictures were successful in guiding participants to experience hazy days and foggy days, because hazy days are more polluted than foggy days but visibility and light quality are both low on these two types of days.

Furthermore, the main effect of priming condition on reported anxiety levels was significant ($F(1, 116) = 13.54, p < .001, \eta^2 = 0.10, 95\% \text{ CI } [0.02, 0.22]$). Participants in the haze condition ($M = 3.22, SD = 0.53$) reported significantly higher anxiety than those in the fog condition ($M = 2.81, SD = 0.68$). Masking and the interaction did not show significant effects upon anxiety ($F(1, 116) = 0.65, p$

= .421, $\eta^2 = 0.01$; $F(1, 116) = 0.57, p = .45, \eta^2 = 0.01$). This indicated that the air pollution resulting from haze contributed to a higher level of anxiety.

With respect to anonymity, a significant main effect of masking ($F(1, 116) = 12.85, p < .001, \eta^2 = 0.10$) was revealed. As predicted, participants with a mask ($M = 4.93, SD = 1.04$) reported a higher level of perceived anonymity than those without a mask ($M = 4.76, SD = 1.36$). There were no significant differences between priming conditions or interactions ($F(1, 116) = 0.61, p = .437, \eta^2 = 0.01$; $F(1, 116) = 3.24, p = .07, \eta^2 = 0.03$). This demonstrated that the manipulation of masking was successful, enhancing the anonymity of participants.

Results showed significant differences between air priming conditions and the occurrence of cheating ($F(1, 116) = 5.24, p = .024, \eta^2 = 0.04$). Participants in the haze condition ($M = 17.52, SD = 16.48$) pressed the cheating key (“H”) more often than those in the fog condition ($M = 11.72, SD = 14.47$). A main effect of masking was also found ($F(1, 116) = 25.64, p < .001, \eta^2 = 0.18$), indicating that individuals wearing a mask ($M = 21.03, SD = 15.63$) cheated more often than those not wearing a mask ($M = 8.20, SD = 13.04$). In addition, the interaction between priming conditions and masking was significant ($F(1, 116) = 5.61, p = .020, \eta^2 = 0.05$). Simple effect analysis suggested that, when participants were not wearing a mask, there were no significant differences in cheating between the hazy priming condition and foggy priming condition ($F(1, 116) < 0.01, p > .05$). However, with a mask, participants primed by haze ($M = 26.93, SD = 14.83$) pressed the cheating “H” key more times than those primed by fog ($M = 15.13, SD = 14.32, F(1, 116) = 10.84, p = .001, \eta^2 = 0.09$). These data demonstrated that wearing a mask and experiencing hazy weather would lead to a greater tendency towards unethical behavior, and individuals wearing a mask on hazy days would be more likely to become involved in cheating (Figure 7).

However, neither haze ($b = 4.54, SE = 2.98, p = .131$) nor anxiety ($b = 3.12, SE = 2.37, p = .190$) were correlated significantly with cheating in the multivariate model. As a result, anxiety was not a significant mediator between haze and unethical behavior (95% CI [-0.48, 3.43]).

Insert Figure 7 here.

3.4.3 Discussion

Participants experiencing hazy weather tended to cheat more frequently relative to those experiencing foggy weather, but this effect was limited to participants who were more anonymous by wearing a mask. Thus, wearing a face mask during hazy days enhances immorality, which could be influenced by haze. Also, the results supported previous findings, which did not show a significant mediating role of anxiety, even with the same measurement as Lu et al. (2018).

4. Discussion

Using big data and the three experiments, it was found that experiencing haze led to unethical behaviors, and that anonymity might be the underlying mechanism. The low visibility of haze boosts perceived anonymity, and thus results in immoral behaviors and judgments. Also, wearing a face mask during hazy days enhances the immorality that haze produces, thereby indicating the moderating role of masking. Additional results also suggested that, though anxiety was increased by haze, it was not the underlying association between haze and unethical behaviors.

4.1 Polluted morality

Our findings suggest that the physical environment and contextual cues could affect the tendency to behave unethically. In accordance with the “broken-windows theory,” it has been found that a disordered physical environment could induce immorality. Indeed, people are more likely to litter, jaywalk and steal when stimulated by disorder in the physical environment (Keuschnigg & Wolbring, 2015). These results corroborate the findings of previous research indicating that on clear days individuals were more likely to return wallets (Zhao, Gao, & Zhou, 2020). Also, embodied cognition posits that the physical environment could activate physical perceptions and related abstract concepts (Huang, Zheng, Tan, Zhang, & Liu, 2016), which could also explain the relationship between weather and immorality. Our research is in line with previous studies asserting polluted morality, which have found that air pollutants could cause more criminal activity (Haynes, Chen, Ryan, Succop, Wright, & Dietrich, 2011), and more counterproductive work behaviors in organizational situations (Feh, Yam, He, Chiang, & Wei, 2017).

More strikingly, the present research proposed anonymity as the underlying mechanism of the ethical costs of haze. In fact, crimes are most likely to happen during low visibility (Hartley, 1974), and darkness promotes aggressive behavior (Karnes, 1960). According to Zhong et al. (2010), the lowered visibility produced by darkness gives rise to a sense of illusory anonymity that triggers unethical behavior. Thus, hazy days might not induce actual anonymity in social interactions, but they produce a higher level of illusory anonymity instead, triggering the belief that one is protected from the attention and scrutiny of other people. In addition, when guards failed to identify with their roles due to disguise and masking, they were found to be more reluctant to impose authority, which also supports the results of the enhanced ethical effects of haze provided by anonymity (Reicher & Haslam, 2006). Resulting from either masking or low visibility, the perceived anonymity increased cheating and unethical behaviors.

4.2 Implications and contributions

The present study has extended understanding of polluted morality in two ways. Theoretically, our findings suggest that the experience of low visibility, combined with the close link between physical and psychological feelings, triggers a fundamental belief that participants are less likely to be seen or identified. Thus, extending previous results, the impact of haze was examined in a real-life situation in which participants experienced low visibility and perceived anonymity with a face mask. Our findings have provided new insights into the underlying factors of polluted morality.

In a practical sense, our findings provide supportive evidence for policymakers. The present research indicated that haze might be the unethical “nudge” that has an extensive influence on the daily life of individuals. A cleaner sky with high air quality could attenuate the potential ethical costs of air pollution. Our results suggest that anonymity, caused either by the low visibility of haze or by masking, may have harmful consequences and induce more unethical behaviors. Moreover, air pollution would give rise to a decline in subjective happiness (Zheng, Wang, Sun, Zhang, & Kahn, 2019). Accordingly, measures could be taken by governments to tackle the adverse effects of anonymity. First, a simple solution would be to invent and manufacture new types of facemasks that are transparent, or smaller masks. A transparent mask could prevent people from inhaling air pollutants on hazy days and also discourage potential aggressive tendencies. A second measure would be for governments to prohibit wearing masks during assemblies and parades, especially on hazy days, which would help to maintain harmony in cities. Moral contagion occurs in parades, when the negative emotions of rebels bring about antisocial and aggressive behaviors (Grappi, Romani, & Bagozzi, 2013). For example, during the riots in Hong Kong in 2019, demonstrators and thugs wore masks, and attacks seemed to be very determined. In these circumstances, wearing a mask would augment further the immorality of these rebels to the extent that the infrastructure of the city may be destroyed. If the revolt happened to be on a polluted day, then it would be tougher to address the violent problems that anonymity may cause to the city.

4.3 Limitations and directions for future research

Our findings indicated that the anonymity brought about by masking contributed to a higher quantity of immoral behaviors. However, the effect of anonymity might also depend on different levels and times of air pollution. Though we have categorized weather as polluted and clean, the extent to which the day is polluted is not well demarcated. A higher level of darkness and polluted air might cause more unethical behaviors (Zhong, Bohns, & Gino, 2010), and different levels of pollution could moderate the impacts of anxiety and anonymity, leading to different results and conclusions.

In addition, considering the fact of the null mediating effect of anxiety and negative emotions in the study, adaptation to air pollution might play a key role. Participants in our study were living in Beijing, which has always been a highly polluted city. According to sensory adaptation, when a

lasting environmental adaptation occurs, it is difficult to modify our emotions unless a seismic change takes place (Smith & Lazarus, 1990). Thus, it might be the case that participants have been used to living under hazy days so that common polluted days would not cause emotional changes and reactions.

Moreover, environmental pollution is a multi-faceted phenomenon: besides environmental dirtiness (air pollution), there are other aspects and subtypes of physical problems in the environment that are worth exploring. For example, how do littering, graffiti, polluted water and other forms of environmental problems affect morality? Thus, it is important for future research to explore the effects of pollution and its psychological mechanisms.

ACKNOWLEDGEMENTS

This work was supported by the NSSF of China (18BSH114) and THU Initiative Scientific Research Program (2017THZWYY11)

The authors are appreciated that Professor Yan XU from Beijing Normal University provided constructive advice for research design.

References

- Anderson, C. A. (2001). Heat and violence. *Current directions in psychological science*, 10(1), 33-38.
- Barnes, C. M., Gunia, B. C., & Wagner, D. T. (2015). Sleep and moral awareness. *Journal of Sleep Research*, 24(2), 181-188.
- Broder, A. (2002). A taxonomy of web search. *Acm Sigir Forum*, 36(2), 3-10.
- Carneiro, H., & Mylonakis, E. (2009). Google trends: a web - based tool for real - time surveillance of disease outbreaks. *Clinical Infectious Diseases*, 49(10), 1557-1564.
- Cohn, E. G., & Rotton, J. (2005). The curve is still out there: a reply to bushman, wang, and anderson's (2005) "Is the curve relating temperature to aggression linear or curvilinear?" *Journal of Personality and Social Psychology*, 89(1), 67-70.
- Detert, J. R., Treviño, L. K., & Sweitzer, V. L. (2008). Moral disengagement in ethical decision making: a study of antecedents and outcomes. *Journal of applied psychology*, 93(2), 374-391.
- Li, H., Wang, X., Guo, Y., Chen, Z., & Teng, F. (2019). Air Pollution Predicts Harsh Moral Judgment. *International Journal of Environmental Research and Public Health*, 16(13), 2276.
- Gong, S., Lu, J. G., Schaubroeck, J. M., Li, Q., Zhou, Q., & Qian, X. (2020). Polluted psyche: is the effect of air pollution on unethical behavior more physiological or psychological? *Psychological science*, 0956797620943835.
- Grappi, S., Romani, S., & Bagozzi, R. P. (2013). Consumer response to corporate irresponsible behavior: Moral emotions and virtues. *Journal of Business Research*, 66(10), 1814 - 1821.
- Guo, M. Z., & Gan, Y.Q. (2010). Reliability and validity of the chinese version of positive and negative affect schedule-expanded in 660 college students. *Chinese Mental Health Journal*, 24(7), 524-528.
- Hartley, J.E. (1974). *Lighting reinforces crime fight*. Pittsfield, MA: Bittenheim.
- Haynes, E. N., Chen, A., Ryan, P., Succop, P., Wright, J., & Dietrich, K. N. (2011). Exposure to airborne metals and particulate matter and risk for youth adjudicated for criminal activity. *Environmental research*, 111(8), 1243-1248.
- Hegarty, W. H., & Sims, H. P. (1978). Some determinants of unethical decision behavior: an experiment. *Journal of Applied Psychology*, 63(4), 451-457.
- Ho, R. C., Zhang, M. W., Ho, C. S., Pan, F., Lu, Y., & Sharma, V. K. (2014). Impact of 2013 south asian haze crisis: study of physical and psychological symptoms and perceived dangerousness of pollution level. *Bmc Psychiatry*, 14(1), 81.
- Huang, Z., Zheng, W., Tan, X., Zhang, X., & Liu, L. (2016). Polluted air increases perceived corruption. *Journal of Pacific Rim Psychology*, 10, 13-20.
- Johansson, M., Pedersen, E., Maleetipwan-Mattsson, P., Kuhn, L., & Laike, T. (2014). Perceived outdoor lighting quality (POLQ): A lighting assessment tool. *Journal of Environmental Psychology*, 39, 14-21.
- Johnson, R. D., & Downing, L. L. (1979). Deindividuation and valence of cues: effects on prosocial and antisocial behavior. *Journal of Personality and Social Psychology*, 37(9), 1532.
- Kaptein, M. (2008). Developing a measure of unethical behavior in the workplace: A stakeholder perspective. *Journal of Management*, 34(5), 978-1008.
- Karnes, E. B. (1960). Well planned lighting is city progress. *American City Magazine*, 75, 104-105.
- Kerr, N. L. (1999). Anonymity and social control in social dilemmas. In M. Foddy, M. Smithson, S. Schneider, & M. Hogg (Eds.), *Resolving social dilemmas* (pp. 103–119). Philadelphia: Psychology Press.
- Keuschnigg, M., & Wolbring, T. (2015). Disorder, social capital, and norm violation: Three field experiments on the broken windows thesis. *Rationality and Society*, 27(1), 96-126.
- Kim, M., Yi, O., & Kim, H. (2012). The role of differences in individual and community attributes in perceived air quality. *Science of the Total Environment*, 425(none), 20-26.
- Kouchaki, M., & Wareham, J. (2015). Excluded and behaving unethically: Social exclusion, physiological responses, and unethical behavior. *Journal of Applied Psychology*, 100(2), 547-556.
- Lambirth, T. T., Gibb, G. D., & Alcorn, J. D. (1986). Use of a behavior-based personality inventory in aviation selection. *Educational and Psychological Measurement*, 46(4), 973-978.

- Li, Q., & Peng, C. H. (2016). The stock market effect of air pollution: Evidence from China. *Applied Economics*, 48(36), 3442-3461.
- Lu, J. G., Lee, J. J., Gino, F., & Galinsky, A. D. (2018). Polluted morality: Air pollution predicts criminal activity and unethical behavior. *Psychological Science*, 29(3), 340-355.
- Lu, J. G. (2019). Air pollution: A systematic review of its psychological, economic, and social effects. *Current Opinion in Psychology*, 32, 52-65.
- Marteau, T. M., & Bekker, H. (1992). The development of a six - item short - form of the state scale of the Spielberger State—Trait Anxiety Inventory (STAI). *British Journal of Clinical Psychology*, 31(3), 301-306.
- Mathes, E. W., & Guest, T. A. (1976). Anonymity and group antisocial behavior. *Journal of Social Psychology*, 100(2), 257-262.
- Mieczysław Szyszkowicz, Willey, J. B., Grafstein, E. , Rowe, B. H. , & Colman, I. . (2010). Air pollution and emergency department visits for suicide attempts in Vancouver, Canada. *Environmental Health Insights*, 4(4), 79-86.
- Miller, F. G., & Rowold, K. L. (1979). Halloween masks and deindividuation. *Psychological Reports*, 44(2), 422-432.
- Ministry of Environmental Protection of the People's Republic of China. (2018, June). Ambient Air Quality Standards. Retrieved November, 2018, from <http://www.mee.gov.cn>
- Page, R. A., & Moss, M. K. (1976). Environmental influences on aggression: The effects of darkness and proximity of victim. *Journal of Applied Social Psychology*, 6(2), 126-133.
- Propst, L. R. (2010). Effects of personality and loss of anonymity on aggression: A revaluation of deindividuation1. *Journal of Personality*, 47(3), 531-545.
- Rajper, S. A., Ullah, S. , & Li, Z. . (2018). Exposure to air pollution and self-reported effects on chinese students: A case study of 13 megacities. *Plos One*, 13(3), e0194364.
- Reicher, S., & Haslam, S. A. (2006). Rethinking the psychology of tyranny: The BBC prison study. *British Journal of Social Psychology*, 45(1), 1-40.
- Rotton, J., Barry, T., Frey, J., & Soler, E. (1978). Air Pollution and interpersonal Attraction. *Journal of Applied Social Psychology*, 8(1), 57-71.
- Sassenberg, K., & Postmes, T. (2002). Cognitive and strategic processes in small groups: Effects of anonymity of the self and anonymity of the group on social influence. *British Journal of Social Psychology*, 41(3), 463-480.
- Silke, A. (2003). Deindividuation, anonymity, and violence: findings from northern ireland. *Journal of Social Psychology*, 143(4), 493-499.
- Smith, C. A., & Lazarus, R. S. (1990). Emotion and adaptation. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research; handbook of personality: Theory and research* (pp. 609-637, Chapter xiv, 738 Pages) The Guilford Press, New York, NY.
- Spivey, C. B., & Prentice-Dunn, S. (1990). Assessing the directionality of deindividuated behavior: Effects of deindividuation, modeling, and private self-consciousness on aggressive and prosocial responses. *Basic and Applied Social Psychology*, 11(4), 387-403.
- Wallace, K. A. (1999). Anonymity. *Ethics and Information technology*, 1(1), 21-31.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, 54(6), 1063-1069.
- White, & Michael, J. (1977). Counternormative behavior as influenced by deindividuating conditions and reference group salience. *The Journal of Social Psychology*, 103(1), 75-90.
- Xiang, P., Geng, L.N., Zhou, K.X, & Cheng, X. (2017). Adverse effects and theoretical frameworks of air pollution: An environmental psychology perspective (in Chinese). *Advances in Psychological Science*, 25(4), 691-700.
- Zhao, Y. J., Gao Y., & Zhou X. Y. (2020). The influence of weather and air pollution on honest behavior: A field experiment about lost wallets on campus (in Chinese). *Acta Psychologica Sinica*, 52(7), 909-920.
- Zheng, S., Wang, J., Sun, C., Zhang, X., & Kahn, M. E. (2019). Air pollution lowers Chinese urbanites' expressed happiness on social media. *Nature Human Behaviour*, 3(3), 237.

- Zhong, C. B., Bohns, V. K., & Gino, F. (2010). Good lamps are the best police: Darkness increases dishonesty and self-interested behavior. *Psychological science*, 21(3), 311-314.
- Zhong, C. B., Strejcek, B., & Sivanathan, N. (2010). A clean self can render harsh moral judgment. *Journal of Experimental Social Psychology*, 46(5), 850-862.
- Zimbardo, P. G. (1969). *Nebraska symposium on motivation* (pp. 202-236). Nebraska, America: University of Nebraska press.

SUPPORTING INFORMATION

Python codes for web scraping Baidu Index of Moral and Immoral words in Study 1a

Demo.py

```
from baidu_index.utils import test_cookies
from baidu_index import config
from baidu_index import BaiduIndex, ExtendedBaiduIndex

cookies = ""

if __name__ == "__main__":

    print(test_cookies(cookies))
    keywords = ['作弊', '贿赂', '欺骗', '盗窃', '犯罪', '真相', '诚实', '原则', '公平', '道德']
    print(config.PROVINCE_CODE)
    print(config.CITY_CODE)
    baidu_index = BaiduIndex(
        keywords=keywords,
        start_date='2017-01-01',
        end_date='2018-1-31',
        cookies=cookies,
        area=911,
    )
    for index in baidu_index.get_index():
        print(index)
```

BaiduIndex.py

```
from urllib.parse import urlencode
import queue
import datetime
import json

import requests
from . import utils
class BaiduIndex:
    _all_kind = ['all', 'pc', 'wise']

    def __init__(
        self,
        *,
        keywords: list,
        start_date: str,
        end_date: str,
        cookies: str,
        kind="news",
        area=0
    ):

        self.keywords = keywords
        self.area = area
```

```

self.start_date = start_date
self.end_date = end_date
self.cookies = cookies
self._params_queue = utils.get_params_queue(start_date, end_date, keywords)

def get_index(self):
    while 1:
        try:
            params_data = self._params_queue.get(timeout=1)
            encrypt_datas, uniqid = self._get_encrypt_datas(
                start_date=params_data['start_date'],
                end_date=params_data['end_date'],
                keywords=params_data['keywords']
            )
            key = utils.get_key(uniqid, self.cookies)
            for encrypt_data in encrypt_datas:
                for kind in self._all_kind:
                    encrypt_data[kind]['data'] = utils.decrypt_func(
                        key, encrypt_data[kind]['data'])
                for formatted_data in self._format_data(encrypt_data):
                    yield formatted_data
        except requests.Timeout:
            self._params_queue.put(params_data)
        except queue.Empty:
            break
    utils.sleep_func()

def _get_encrypt_datas(self, start_date, end_date, keywords):
    """
    :start_date; str, 2018-10-01
    :end_date; str, 2018-10-01
    :keyword; list, ['1', '2', '3']
    """
    request_args = {
        'word': json.dumps([[{'name': keyword, 'wordType': 1}] for keyword in keywords]),
        'startDate': start_date.strftime('%Y-%m-%d'),
        'endDate': end_date.strftime('%Y-%m-%d'),
        'area': self.area,
    }
    url = 'http://index.baidu.com/api/SearchApi/index?' + urlencode(request_args)
    html = utils.http_get(url, self.cookies)
    datas = json.loads(html)
    uniqid = datas['data']['uniqid']
    encrypt_datas = []
    for single_data in datas['data']['userIndexes']:
        encrypt_datas.append(single_data)
    return (encrypt_datas, uniqid)

def _format_data(self, data):
    keyword = str(data['word'])
    start_date = datetime.datetime.strptime(data['all']['startDate'], '%Y-%m-%d')
    end_date = datetime.datetime.strptime(data['all']['endDate'], '%Y-%m-%d')
    date_list = []
    while start_date <= end_date:
        date_list.append(start_date)

```



```

start_date += datetime.timedelta(days=1)

for kind in self._all_kind:
    index_datas = data[kind]['data']
    for i, cur_date in enumerate(date_list):
        try:
            index_data = index_datas[i]
        except IndexError:
            index_data = ''
        formatted_data = {
            'keyword': json.loads(keyword.replace('\', '\"'))[0]['name'],
            'type': kind,
            'date': cur_date.strftime('%Y-%m-%d'),
            'index': index_data if index_data else '0'
        }
    yield formatted_data

```

Figure Legends

Fig. 1 Interaction between word category and air quality on Baidu Index for Moral Words and Immoral Words. (Study 1a)

Fig. 2 Study 1b: sample photographs of cities with different air quality

The left picture shows a “haze” condition, the middle picture shows a “clear” condition, and the right picture shows a “fog” condition. (Study 1b)

Fig. 3 Example of unsolvable matrix (Study 1b)

Fig. 4 Testing the mediating role of anonymity provided by low visibility

Note. * $p < .05$. ** $p < .01$.

Fig. 5 A sample of gauze mask

Fig. 6 Dot estimation task

Fig. 7 Effect of the interaction between haze and masking upon cheating

Figures

Figure 1

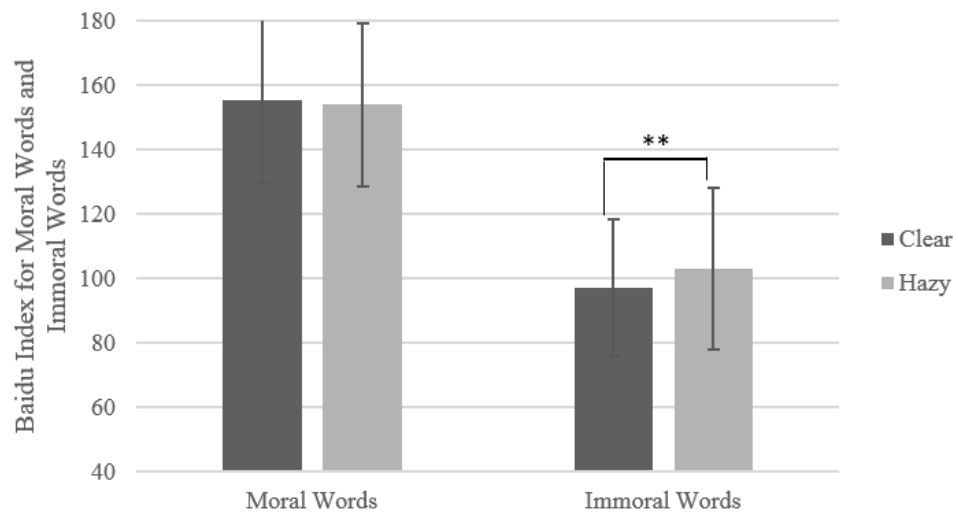


Figure 1. Interaction between word category and air quality on Baidu Index for Moral Words and Immoral Words. (Study 1a)

Figure 2



Figure 2. Study 1b: sample photographs of cities with different air quality

The left picture shows a “haze” condition, the middle picture shows a “clear” condition, and the right picture shows a “fog” condition. (Study 1b)

Figure 3

1.69	1.82	2.91
4.67	4.82	3.05
5.82	5.06	4.28
6.36	5.19	4.57

Figure 3. Example of unsolvable matrix (Study 1b)

Figure 4

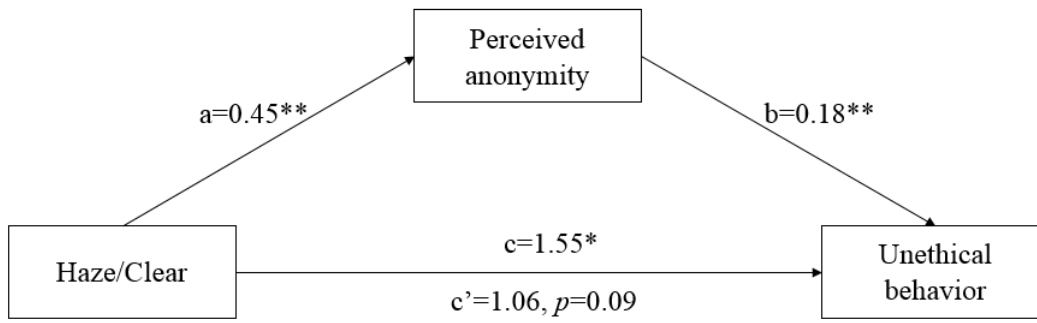


Figure 4. Testing the mediating role of anonymity provided by low visibility

Note. * $p < .05$. ** $p < .01$.

Figure 5



Figure 5. A sample of gauze mask

Figure 6

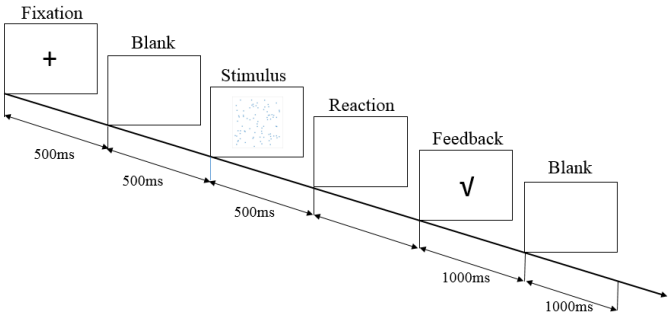


Figure 6. Dot estimation task

Figure 7

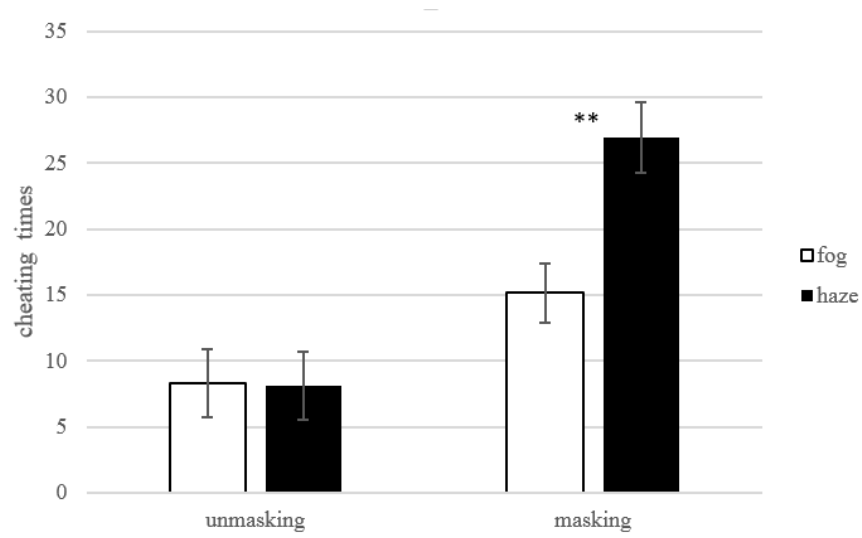


Figure 7. Effect of the interaction between haze and masking upon cheating

Tables

Table 1

Table 1. Daily average AQI (Study 2)

Date	22 Apr.	23 Apr.	25 Apr.	26 Apr.
AQI	127	127	38	44
Condition	Hazy	Hazy	Clear	Clear

Table 2

Table 2. Descriptive statistics and correlations (Study 2)

Variable	<i>M</i>	<i>SD</i>	1	2	3	4
1. Air quality	4.10	1.38	1			
2. Visibility	4.60	1.32	0.69***	1		
3. Anonymity	3.92	0.81	−0.19	−0.28*	1	
4. Cheating	2.70	2.90	−0.24*	−0.03	0.35**	1

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.